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We hope the standard of the new president from the West will be quality first, and quantity afterward. Although in one sense he can hardly equal the success of this year, a higher kind of success desired by those who voted for him is possible. If he has the strength and wisdom to make it against all the solicitations which will tempt him, the most important new departure since the association was founded may be quietly made next year, even by a very small convention, in which quality shall be made the touchstone of all.

#### A BURROWING SPIDER.

In the somewhat heavy soil of certain fields, where but a scanty herbage thrives, the cave-making spider (*Tarantula arenicola*, as identified by the Rev. Dr. H. C. McCook) has excavated so many of the nearly perpendicular and cylindrical burrows, that the place is almost honeycombed, and the surface is conspicuously dotted by the irregularly five-sided towers erected above each opening. The burrows vary from one-quarter to three-quarters of an inch in diameter, and in depth from eight to twelve, or even twenty, inches; the smaller being formed, it is said, by the young, which enlarge them with their growth. The walls are compact and smooth, but without lining. Towers in other localities have been observed two inches high: none I have seen are above one inch, the majority being still less.

Among my captives, the most active workers are an adult and a half-grown individual, between whose actions, while digging, slight differences are observable. In a glass jar they refused to do more than attempt to escape by unavailing efforts to scale the sides, but, when set free in the garden, they at once began to exhibit their manner of burrowing, and disposing of the excavated earth. Most of the labor is performed by the large and strong mandibles, with the probable assistance of the fore-legs. A pellet of earth, frequently a third of the worker's cephalothorax in bulk, is loosened as the spider labors head downward, and is seized by the mandibles. The young spider turns at the bottom of the burrow, and ascends, head first, to the edge of the aperture, where the pellet is held just above the surface; then, by a blow from both fore-legs, it is thrown to a distance varying from four to twelve inches, usu-

ally falling in particles, so that no fresh earth is noticeable near the burrow-entrance. The half-grown individual then backs down the tube, and resumes work below. The mature spider, while the pit is shallow, ascends backward with the load, comes entirely out of the orifice, turns around, and, having popped the abdomen into the opening, throws away the pellet. She rests for a few moments, again turns within the cave, and descends, head foremost. Before returning to work below, however, she often carefully examines the edges of the burrow-entrance, and, if the earth has become dry and friable, strengthens it by threads of web, applied by longitudinal strokes of the spinnerets; and, if her movements have broken down the margins, she places her head under the edge, pushing and lifting the earth in a way suggestive of a dog's method of heaping dirt on a bone with his nose. She then applies more web, and resumes her digging. But, as the burrow deepens, the mature spider also turns while below. I have, however, never observed a young individual bring up a pellet backward.

That the spinnerets of this species take any part in pellet-making is improbable. Mrs. Mary Treat, while studying *Tarantula turricula*, observed their application to the earth-mass before its ejection. It is likely that *Tarantula arenicola* relies solely on the cohesion of the moist particles, without the addition of strengthening web, as I have repeatedly witnessed the dry soil of the field crumble to sand before the spider could get the pellet quite out of the tube.

The young specimen brought up a load at intervals varying from two to five minutes; and a cavern half an inch across and about one inch deep was excavated in an hour and a half. While deepening a burrow, a young spider in the field worked somewhat faster. Assuming a pit to be of the uniform width of three-quarters of an inch and twelve inches deep, the *Tarantula* must carry out the comparatively enormous amount of 5.31 cubic inches of earth.

The towers are usually composed of short pieces of grass (fig. 1) placed above and across each other in an irregularly five-sided wall. Occasionally small twigs are used. Indeed, almost any light object will be utilized if within reach, for the spider will not leave the burrow to search for materials. If nothing is attainable without such an effort, she will erect a low wall of earth. In several instances towers have been destroyed, and the ground cleared for a space of three inches radius; and from another place the sod was removed: but, in

every case, the spiders raised a bulwark of earth, one having attached a single sliver of pine shaving, the only thing within her reach. At times the grass is curved around the opening, as if a wisp had been taken, and the tower formed at almost a single stroke, without the labor involved in placing each blade separately. Near the favorite field, a housewife, in the annual frenzy of housecleaning, had thrown out a quantity of coarse straw, which some of the Tarantulas utilized by erecting towers (fig. 2) of comparatively immense straw logs. Two miles from the latter was found a lofty edifice (fig. 3) built of large pieces of brown, partially decayed wood from an old railroad tie. Mrs. Treat has witnessed their construction by another species. I have not observed the entire process.

The spiders' favorite position is a crouching one at the summit, the legs within the tower, and supported by the walls. At the sight of any approaching object, they dart backward into the burrow. They are not disturbed by surface vibrations. Footsteps, even the passage of a heavy wagon within five yards of the pit, do not affect them; but the slightest movement of the observer, two feet distant, or the sudden swaying of a bush, sends them to the burrow immediately. Dr. H. C. McCook, writing in a popular magazine, says of the use of these erections, that "they probably serve

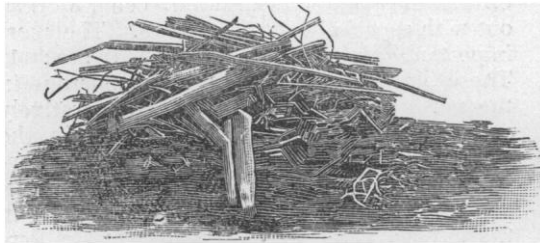


FIG. 2.

as watch-towers, from which the keeper may observe the approach of her enemies," as an attraction to roving insects, and perhaps to prevent flooding of the cavern by rain. The towers in this locality are far from being waterproof: they are used exclusively, I think, to facilitate the capture of food. But observers,

so far as I am aware, have made no statements as to the method of food-capture, when the food fails to voluntarily scale the walls.

The towers are observatories and transmitters of signals to the spider when below. From them she scans the field, as the robber barons of the olden time, from their battlements, watched for the coming of the caravan. The spider peers through the scanty grass-blades, selects her victim, and, as I have witnessed, leaps from the summit to seize the prey. I have seen her spring at a fly on the ground, missing it, of course. But

she does not always wait for food until the pit and tower are completed. I have seen her dart from the edge of an unfinished burrow, capture an ant three inches distant, and retire to the shallow cave. Ten minutes later she re-appeared empty-handed, and almost immediately attempted to seize another near by, but failed to do more by her frantic efforts than scrape up a heap of loose earth.

The towers are so loosely constructed that an ant can scarcely run over the walls without making enough rattling to admonish the concealed spider, which at once hurries to the top, and, if the insect is acceptable, takes it in. A black ant running over the foundations almost invariably brings the spider up; and the gentle tapping of a straw, or even dragging a

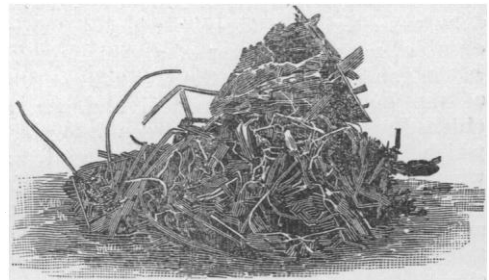


FIG. 3.

straw across the dead grass in contact with the walls, is quite sure to be followed by the arachnid's appearance. The sense of direction, or the ability to perceive whence the disturbance proceeds, is well developed. The spider always ascends on that side to which the straw is applied, and the same individual

can be brought to each side in succession. The depth of the cavern seems to have little effect. I have called up the occupant from a burrow which subsequent examination has proved to be eighteen inches deep. Unless she has been deceived several times, she usually runs up rapidly, and will occasionally snap at the end of the straw. While experimenting, it is hardly possible to avoid introducing fragments of the tower, or adherent particles of earth, and it occurred to me that these might be the call to which the spider responded; but sand from an ant-hill, sprinkled in freely, had no effect.

Mrs. Mary Treat, writing of another species of *Tarantula*, says that all food-remains were ejected in the same way as the earth pellets. *Tarantula arenicola* is not so neat. The earth beneath old burrows is often darker than the walls, and densely filled with fine rootlets. It is probably darkened and enriched by the spider's excrement and food-remains. From burrows in the field it is the rule to take masses of *débris*, which consist of the spider's exuviae, the heads and legs of ants, the elytra and other chitinous parts of beetles, with fragments of insect-wings. It seems that the dead and empty bodies are torn to pieces, and scattered at the bottom. This was done by a captive which would not dig, but which accepted maimed flies. After extracting the juices, the spider tore the body into fragments so small that only careful search could find them. In but two instances have I observed an ejection of food-remains. A mutilated fly was seized from a tower, and twenty-four hours later I did find what appeared to be the desiccated remains. In the second case, two spiders were fighting fiercely when set free at evening, near the burrow of a small specimen in the garden. During the night the occupant of the burrow was dislodged, and the vanquished spider had been dragged into the pit which the conqueror had enlarged, and whence, in the course of the morning, fragments of the dead body were thrown out, among them the abdomen severed from the thorax, but not otherwise mutilated. Occasionally, also, an elytron can be found near a tower in the field.

This disposition of remnants is somewhat remarkable; since spiders in general are cleanly, and since this one is particularly intolerant of intrusive objects. A straw or stem dropped into the burrow is immediately carried up, and tossed away. The only instance observed, where a young spider ascended backward, was when trying to get a heavy stick out of

the pit: having lifted in vain, she attempted to pull.

Noticing the fondness for ants, a number of bran-cracker crumbs were sprinkled at a distance of six inches from the tower, and an ant was soon struggling under a load larger than itself. Suddenly the spider on the tower started, erect and rigid: she leaped to the ground, she ran six inches, she seized that bit of cracker, and retreated with it to her burrow, leaving the emmet on its back in the dust. For two hours she remained below. The following day I twice witnessed the same performance. The spider once overran the crumb, and so lost it. At the third time, the piece of biscuit became wedged in the tower as the spider was running in backward, and I plainly saw her nibbling at it. During a momentary absence for forceps to remove it, to examine for marks of mandibles, the spider carried it down and out of sight. The fragments were not touched, except as they were being borne about by the ants. Is it usual for spiders to take any but animal food?

DR. ALFRED C. STOKES.

#### THE EXPLORING VOYAGE OF THE CHALLENGER.

(Second Notice.)<sup>1</sup>

PROFESSOR HERDMAN has published the first part of his memoir upon the Tunicata (vol. vi., 296 p., 37 pl.), which treats solely of the 'Ascidiae simplices,' the composite and pelagic forms being reserved for future consideration. From the historical preface to the index, this report is a model of systematic arrangement; the bibliography, and the chapter on anatomy and classification, being worked out with especially elaborate care. The most important generalizations reached are: 1. These simple ascidians are not numerous in the northern hemispheres, are comparatively scarce in tropical latitudes, and attain the greatest abundance in southern temperate regions; 2. Although simple ascidians occur in very deep water, and are fairly represented in the abyssal zone, they are chiefly a shallow-water group, and are most numerous around coasts in a few fathoms of water; 3. The occurrence of simple ascidians does not depend upon temperature or character of bottom. The discussion of questions affecting the Tunicata as a class is reserved for the second part of the report. The phylogenetic table on p. 286 is of great interest.

<sup>1</sup> See No. 66.